

Translation

PATENT COOPERATION TREATY

PCT

INTERNATIONAL PRELIMINARY EXAMINATION REPORT

(PCT Article 36 and Rule 70)

Applicant's or agent's file reference 50308715	FOR FURTHER ACTION See Notification of Transmittal of International Preliminary Examination Report (Form PCT/IPEA/416)	
International application No. PCT/JP2003/015636	International filing date (day/month/year) 05 December 2003 (05.12.2003)	Priority date (day/month/year) 06 December 2002 (06.12.2002)
International Patent Classification (IPC) or national classification and IPC G02B 6/12		
Applicant JAPAN SCIENCE AND TECHNOLOGY AGENCY		

1. This international preliminary examination report has been prepared by this International Preliminary Examining Authority and is transmitted to the applicant according to Article 36.
2. This REPORT consists of a total of <u>7</u> sheets, including this cover sheet. <input checked="" type="checkbox"/> This report is also accompanied by ANNEXES, i.e., sheets of the description, claims and/or drawings which have been amended and are the basis for this report and/or sheets containing rectifications made before this Authority (see Rule 70.16 and Section 607 of the Administrative Instructions under the PCT). These annexes consist of a total of <u>5</u> sheets.
3. This report contains indications relating to the following items: I <input checked="" type="checkbox"/> Basis of the report II <input type="checkbox"/> Priority III <input type="checkbox"/> Non-establishment of opinion with regard to novelty, inventive step and industrial applicability IV <input type="checkbox"/> Lack of unity of invention V <input checked="" type="checkbox"/> Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement VI <input type="checkbox"/> Certain documents cited VII <input checked="" type="checkbox"/> Certain defects in the international application VIII <input checked="" type="checkbox"/> Certain observations on the international application

Date of submission of the demand 26 February 2004 (26.02.2004)	Date of completion of this report 08 November 2004 (08.11.2004)
Name and mailing address of the IPEA/JP Facsimile No.	Authorized officer Telephone No.

INTERNATIONAL PRELIMINARY EXAMINATION REPORT

International application No.

PCT/JP2003/015636

I. Basis of the report

1. With regard to the elements of the international application:*

- ☐ the international application as originally filed
- ☒ the description:
pages 1-17, as originally filed
pages _____, filed with the demand
pages _____, filed with the letter of _____
- ☒ the claims:
pages 11-20, as originally filed
pages _____, as amended (together with any statement under Article 19
pages _____, filed with the demand
pages 1-6, 8-10, filed with the letter of 23 July 2004 (23.07.2004)
- ☒ the drawings:
pages 1-2, 4-12, as originally filed
pages _____, filed with the demand
pages 3, filed with the letter of 23 July 2004 (23.07.2004)
- ☐ the sequence listing part of the description:
pages _____, as originally filed
pages _____, filed with the demand
pages _____, filed with the letter of _____

2. With regard to the language, all the elements marked above were available or furnished to this Authority in the language in which the international application was filed, unless otherwise indicated under this item.

These elements were available or furnished to this Authority in the following language _____ which is:

- ☐ the language of a translation furnished for the purposes of international search (under Rule 23.1(b)).
- ☐ the language of publication of the international application (under Rule 48.3(b)).
- ☐ the language of the translation furnished for the purposes of international preliminary examination (under Rule 55.2 and/or 55.3).

3. With regard to any nucleotide and/or amino acid sequence disclosed in the international application, the international preliminary examination was carried out on the basis of the sequence listing:

- ☐ contained in the international application in written form.
- ☐ filed together with the international application in computer readable form.
- ☐ furnished subsequently to this Authority in written form.
- ☐ furnished subsequently to this Authority in computer readable form.
- ☐ The statement that the subsequently furnished written sequence listing does not go beyond the disclosure in the international application as filed has been furnished.
- ☐ The statement that the information recorded in computer readable form is identical to the written sequence listing has been furnished.

4. ☒ The amendments have resulted in the cancellation of:

- ☐ the description, pages _____
- ☒ the claims, Nos. 7
- ☐ the drawings, sheets/fig _____

5. ☐ This report has been established as if (some of) the amendments had not been made, since they have been considered to go beyond the disclosure as filed, as indicated in the Supplemental Box (Rule 70.2(c)).**

* Replacement sheets which have been furnished to the receiving Office in response to an invitation under Article 14 are referred to in this report as "originally filed" and are not annexed to this report since they do not contain amendments (Rule 70.16 and 70.17).

** Any replacement sheet containing such amendments must be referred to under item 1 and annexed to this report.

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International application No.
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V. Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement

1. Statement

Novelty (N)	Claims	4-6, 8-20	YES
	Claims	1-3	NO
Inventive step (IS)	Claims	5-6, 8-10, 16-20	YES
	Claims	1-4, 11-15	NO
Industrial applicability (IA)	Claims	1-6, 8-20	YES
	Claims		NO

2. Citations and explanations

- Document 1: A. Chutinan et al., Applied Physics Letters, October 22, 2001 (10.22.01), Vol. 79, No. 17, pp. 2690-2692
- Document 2: Taku ASANO et al, "2-Jigen Photonics Kessho ni yoru Hacho Gobunha Device -Ten Kekkan Kan no Kansho -," 2002 Nen Shunki Dai 49 Kai Oyo Butsuri gaku Kankei Rengo Koenkai Koen Yokoshu, March 27, 2002 (03.27.02), separate Vol. 3, p. 1039
- Document 3: WO, 00/59140, A1 (Deutsche Telekom AG), October 5, 2000 (10.05.00), Figs. 1 and 3 & JP, 2002-540481, A & EP, 1166474, A1 & US, 6760513, B1 & DE, 19915139, A1
- Document 4: WO, 01/77726, A1 (BTG International Limited) October 18, 2001 (10.18.01) Fig. 40 & JP, 2003-530589, A & EP, 1269229, A1 & US, 2004/0091224, A1
- Document 5: JP, 11-218627, A (Nippon Telegraph and Telephone Corporation), August 10, 1999 (08.10.99), Fig. 8
- Document 6: Rimitsu MOCHIDUKI et al., 2-Jigen Photonics Kessho ni yoru Hacho Gobunha Device - Fukusu no Koshiten o umeta Donor Gata Kekkan ni yoru Q-chi no Kojo-, 2002 Nen Shunki Dai 49 Kai Oyo Butsuri gaku Kankei Rengo Koenkai Koen Koyoshu, March 27, 2002 (03.27.02), separate Vol. 3, p1039

Claims 1-3

In each of document 1 and document 2 cited in the ISR, an incidence end face of a linear defect waveguide formed on a two-dimensional photonic crystal slab and an end face opposite to the incident end face are formed of a boundary of an air layer and two-dimensional photonic crystal slab body, that is, a boundary of materials with the different refractive index. The fact that a boundary of materials with differing refractive indices is reflective is common technical knowledge for a party skilled in the art; therefore, documents 1 and 2 also have two reflection parts in a waveguide end.

Therefore, the inventions relating to claims 1-3 do not appear to be novel or involve an inventive step based on each of documents 1 and 2.

Claim 4

Document 3 describes forming a reflection part made of a photonic crystal on a waveguide end.

Therefore, as the reflection part of document 1 and document 2 cited in the ISR, forming a reflection part comprising a photonic crystal of document 3 would be easy for a party skilled in the art.

Therefore, the invention relating to claim 4 does not appear to involve an inventive step based on documents 1 and 3 and document 2 cited in the ISR.

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International application No.

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V. Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement

1. Statement

Novelty (N)	Claims	4-6, 8-20	YES
	Claims	1-3	NO
Inventive step (IS)	Claims	5-6, 8-10, 16-20	YES
	Claims	1-4, 11-15	NO
Industrial applicability (IA)	Claims	1-6, 8-20	YES
	Claims		NO

2. Citations and explanations

Document 1: A. Chutinan et al., Applied Physics Letters, October 22, 2001 (10.22.01), Vol. 79, No. 17, pp. 2690-2692

Document 2: Taku ASANO et al., "2-Jigen Photonics Kessho ni yoru Hacho Gobunha Device -Ten Kekkan Kan no Kansho -," 2002 Nen Shunki Dai 49 Kai Oyo Butsuri gaku Kankei Rengo Koenkai Koen Yokoshu, March 27, 2002 (03.27.02), separate Vol. 3, p. 1039

Document 3: WO, 00/59140, A1 (Deutsche Telekom AG), October 5, 2000 (10.05.00), Figs. 1 and 3 & JP, 2002-540481, A & EP, 1166474, A1 & US, 6760513, B1 & DE, 19915139, A1

Document 4: WO, 01/77726, A1 (BTG International Limited) October 18, 2001 (10.18.01) Fig. 40 & JP, 2003-530589, A & EP, 1269229, A1 & US, 2004/0091224, A1

Document 5: JP, 11-218627, A (Nippon Telegraph and Telephone Corporation), August 10, 1999 (08.10.99), Fig. 8

Document 6: Rimitsu MOCHIDUKI et al., 2-Jigen Photonics Kessho ni yoru Hacho Gobunha Device - Fukusu no Koshiten o umeta Donor Gata Kekkan ni yoru Q-chi no Kojo-, 2002 Nen Shunki Dai 49 Kai Oyo Butsuri gaku Kankei Rengo Koenkai Koen Koyoshu, March 27, 2002 (03.27.02), separate Vol. 3, p1039

Claims 1-3

In each of document 1 and document 2 cited in the ISR, an incidence end face of a linear defect waveguide formed on a two-dimensional photonic crystal slab and an end face opposite to the incident end face are formed of a boundary of an air layer and two-dimensional photonic crystal slab body, that is, a boundary of materials with the different refractive index. The fact that a boundary of materials with differing refractive indices is reflective is common technical knowledge for a party skilled in the art; therefore, documents 1 and 2 also have two reflection parts in a waveguide end.

Therefore, the inventions relating to claims 1-3 do not appear to be novel or involve an inventive step based on each of documents 1 and 2.

Claim 4

Document 3 describes forming a reflection part made of a photonic crystal on a waveguide end.

Therefore, as the reflection part of document 1 and document 2 cited in the ISR, forming a reflection part comprising a photonic crystal of document 3 would be easy for a party skilled in the art.

Therefore, the invention relating to claim 4 does not appear to involve an inventive step based on documents 1 and 3 and document 2 cited in the ISR.

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VII. Certain defects in the international application

The following defects in the form or contents of the international application have been noted:

A “second body end part 73” of page 16, line 13 is an error for a “second body end part 74.”

VIII. Certain observations on the international application

The following observations on the clarity of the claims, description, and drawings or on the question whether the claims are fully supported by the description, are made:

(1) Page 3, lines 2-4 describes that the purpose of the invention of the present application is "to provide a two-dimensional photonic crystal multiplexer/demultiplexer having high multiplexing efficiency and demultiplexing efficiency." The written reply of July 23, 2004 (07.23.04) asserts that "high" "multiplexing efficiency and demultiplexing efficiency" in the above description does not mean that the multiplexing efficiency and demultiplexing efficiency are 50% or more, as is described in page 2, line 23 – page 3, line 1.

However, on the premise of this assertion, it is not clear how much multiplexing efficiency and demultiplexing efficiency would enable the attainment of the purpose of the invention of the present application.

(2) Claim 1 merely describes a special matter of the invention is that a "first reflection part" and "second reflection part" are such that "the resonance of a spot defect reflects at least a part of long lights." Thus, the invention relating to claim 1 includes cases of, for example, "partial reflection" rate in the "first reflection part" and "second reflection part," that is, cases where the refractive index is 1%, 5%, 10% and 18% (18% is given as an example based on page 16, lines 9-13).

However, as in these cases, if the refractive index of the "first reflection part" and/or "second reflection part" is greatly lower than a calculation example of the present application, obviously, it is clear that the purpose of the invention of the present application, that is, "to provide a two-dimensional photonic crystal multiplexer/demultiplexer having high multiplexing efficiency and demultiplexing efficiency," cannot be achieved.

(3) Page 6, lines 3-17 describes that "when light reflected by the first reflection part and light reflected by the spot defect overlap, the distance between the spot defect and the first reflection part is set so as to be weakened by interference, that is, so that the phase difference between the two becomes π ," thereby improving "optical multiplexing efficiency."

On the other hand, page 6, line 27 – page 7, line 7 describes that when a second reflection part is provided, "the distance between a spot defect and second reflection part is set so that light in the spot defect direction introduced to a waveguide and light reflected by the spot defect and first reflection part and further reflected by the second reflection part are strengthened by interference, that is, so that the phase difference between the two becomes zero," thereby improving "optical multiplexing efficiency."

Therefore, both descriptions contradict each other in the point of the phase difference when optical multiplexing efficiency is improved.

(4) Page 7, line 17 – page 8, line 3 describes that, when a "first reflection part is entirely reflective" and under the conditions where "L is set so that the phase difference of light reflected by the first reflection part and light reflected by the spot defect becomes π ," "if Q_p/Q_v is 1.4-2.8, multiplexing efficiency becomes 97% or more, at which point loss is substantially negligible."

Thus, when Q_p/Q_v is extremely small (for example, 0.01) or Q_p/Q_v is extremely large (for example, 100), multiplexing efficiency lowers.

However, none of claims 1-6, 8 and 11-17 describes a relationship between Q_p and Q_v ; therefore, claims 1-6, 8 and 11-17 obviously include a case where the purpose of the invention of the present application, that is, "to provide a two-dimensional photonic crystal multiplexer/demultiplexer having high multiplexing efficiency and demultiplexing efficiency" cannot be achieved, such as a case where a value of Q_v in the ratio is extremely small.

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Supplemental Box

(To be used when the space in any of the preceding boxes is not sufficient)

Continuation of Box V:

Claims 11 and 13-15

Connecting photonic crystals with different periods in the optical axis direction, and having light reflect on the connection part (boundary part) of the photonic crystals with different periods were well known prior to the filing of the present application (for example, see documents 4-5).

Therefore, as the reflection part of document 1 and document 2 cited in the ISR, forming a reflection part comprising a connection part of photonic crystals with different periods of documents 4-5 could be easy for a party skilled in the art.

Therefore, the inventions relating to claims 11 and 13-15 do not appear to involve an inventive step based on documents 1 and 4-5 and document 2 cited in the ISR.

Claim 12

Configuring a spot defect as a linear donor-type cluster defect formed by making defective three adjoining regions with the different refractive indices is described in document 6.

Therefore, as a spot defect of document 1 and document 2 cited in the ISR, configuring a linear donor-type cluster defect formed by making defective three adjoining regions with the different refractive indices, as described in cited document 6, could be easily conceived of by a party skilled in the art.

Therefore, the invention relating to claim 12 does not appear to involve an inventive step based on documents 1 and 4-6 and document 2 cited in the ISR.

Claims 5-6, 8-10 and 16-20

The inventions relating to claims 5-6, 8-10 and 16-20 are not described in any of documents 1 and 3-6 and document 2 cited in the ISR; nor are they obvious to a party skilled in the art.

Supplemental Box

(To be used when the space in any of the preceding boxes is not sufficient)

Continuation of Box VIII:

(5) Page 6, lines 3-17 describes that, when a "first reflection part comprises a boundary between slab and air," the "distance between the spot defect and first reflection part becomes $n/2$ -fold (n is a positive integer) of the spot defect resonance wavelength," that is, "the phase difference between light having resonance wavelength in the spot defect and introduced from the spot defect to a waveguide and light reflected by the first reflection part with the same wavelength" becomes $n\pi$ (n is a positive odd integer), both multiplexing efficiency and demultiplexing efficiency should improve.

Thus, "when the first reflection part comprises a boundary between slab and air," "the distance between the spot defect and first reflection part becomes $(2n-1)/4$ -fold (n is a positive odd integer, hereinafter the same) of the resonance wavelength of the spot defect, that is, when "the phase difference between light having resonance wavelength in the spot defect and introduced from the spot defect to the waveguide and light reflected by the first reflection part with the same wavelength" becomes $n\pi$ (n is a positive odd number), both multiplexing efficiency and demultiplexing efficiency should lower.

Thus, none of claims 1-4, 9-10, 11-15 and 18-20 describes a value of the "phase difference between light having resonance wavelength in the spot defect and introduced from the spot defect to the waveguide and light reflected by the first reflection part with the same wavelength." Also, claims 5-6, 8 and 16-17 describe the "phase difference between light having resonance wavelength in the spot defect and introduced from the spot defect to the waveguide and light reflected by the first reflection part with the same wavelength"; however, they do not describe whether the phase difference of the reflection light at the time of reflection on the "first reflection part" remains the same or the phase of the reflection light reverses.

Therefore, the inventions relating to claims 1-6 and 8-20 obviously include a case where both multiplexing efficiency and demultiplexing efficiency lower.

(6) Claims 11-20 describe a "two-dimensional photonic crystal multiplexer/demultiplexer utilizing boundary reflection."

However, even though descriptions of the other sections in claim 11 are referred to, the meaning of the "boundary" is not clear as to which boundary it is.

Therefore, the inventions relating to claims 11-20 are not clear.